



[4910-13]

## **DEPARTMENT OF TRANSPORTATION**

### **Federal Aviation Administration**

#### **14 CFR Part 23**

[Docket No. FAA-2019-0805; Special Condition No. 23-298-SC]

### **Special Conditions: Diamond Aircraft Industries of Canada Model DA-62 Airplanes; Diesel Cycle Engine Installation**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final special conditions, request for comments.

**SUMMARY:** These special conditions are issued for the Diamond Aircraft Industries of Canada DA-62 airplane. This airplane will have novel or unusual design features associated with the installation of a diesel cycle engine utilizing turbine fuel. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** These special conditions are effective [INSERT DATE OF PUBLICATION IN FEDERAL REGISTER].

The FAA must receive your comments by [INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]

**ADDRESSES:** Send comments identified by docket number FAA-2019-0805 using any of the following methods:

- ☐ Federal eRegulations Portal: Go to <http://www.regulations.gov> and follow the online instructions for sending your comments electronically.
- ☐ Mail: Send comments to Docket Operations, M-30, U.S. Department of Transportation (DOT), 1200 New Jersey Avenue, SE., Room W12-140, West Building Ground Floor, Washington, D.C., 20590-0001.
- ☐ Hand Delivery of Courier: Take comments to Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, S.E., Washington, D.C., between 9 a.m., and 5 p.m., Monday through Friday, except Federal holidays.
- ☐ Fax: Fax comments to Docket Operations at 202-493-2251.

Privacy: The FAA will post all comments it receives, without change, to <http://regulations.gov>, including any personal information the commenter provides. Using the search function of the docket web site, anyone can find and read the electronic form of all comments received into any FAA docket, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). DOT's complete Privacy Act Statement can be found in the Federal Register published on April 11, 2000 (65 FR 19477-19478), as well as at <http://DocketsInfo.dot.gov>.

Docket: Background documents or comments received may be read at <http://www.regulations.gov> at any time. Follow the online instructions for accessing the docket or go to the Docket Operations in Room W12-140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, D.C., between 9 a.m., and 5 p.m., Monday through Friday, except Federal holidays.

**FOR FURTHER INFORMATION CONTACT:** Jeff Pretz, AIR-691, Small Airplane Standards Branch, Policy & Innovation Division, Aircraft Certification Service, Federal Aviation Administration, 901 Locust, Room 301, Kansas City, MO, 64106; telephone (816) 329-3239; facsimile (816) 329-4090.

**SUPPLEMENTARY INFORMATION:**

**Reason for No Prior Notice and Comment Before Adoption**

The FAA has determined, in accordance with 5 U.S. Code 553(b)(3)(B) and 553(d)(3), that notice and opportunity for prior public comment hereon are unnecessary because substantially identical special conditions have been subject to the public comment process in several prior instances such that the FAA is satisfied that new comments are unlikely. For the same reason, the FAA finds that good cause exists for making these special conditions effective upon issuance. The FAA is requesting comments to allow interested persons to submit views that may not have been submitted in response to the prior opportunities for comment.

Special Condition Number <sup>2</sup>	Company/Airplane Model
23-169-SC	Diamond Aircraft Industries GmbH/DA 42, DA 42 NG, DA 42 M-NG, and DA62
23-185-SC	Piper/PA28-236
23-188-SC	Piper/PA28-161
23-259-SC	Cessna Aircraft Company/J183T

**Comments Invited**

The FAA invites interested people to take part in this rulemaking by sending written comments, data, or views. The most helpful comments reference a specific portion of the special conditions, explain the reason for any recommended change, and include supporting data.

---

<sup>2</sup> See <http://rgl.faa.gov/> to review the listed special conditions.

The FAA will consider all comments received on or before the closing date for comments. The FAA will consider comments filed late if it is possible to do so without incurring expense or delay. The FAA may change these special conditions based on the comments received.

## **Background**

On November 16, 2018, Diamond Aircraft Industries of Canada (DAI-Canada) applied for FAA validation for a new type certificate for its Model DA-62 airplane. The Model DA-62 is a normal category, composite, 6 place (excluding pilots seats), twin-engine airplane with retractable gear, cantilevered low-wing and T-tail monoplane, and a maximum takeoff weight of 4,407 pounds. The airplane is powered by two Austro Engine GmbH E4P aircraft diesel engines (E4P), which are type certificated in the United States (TC No. E00081EN).

The DAI-Canada Model DA-62 is the same design as the Diamond Aircraft Industries GmbH Model DA62, a normal category airplane type certificated under the airworthiness standards listed in Type Certificate Data Sheet (TCDS) No. A57CE. The FAA issued special conditions to the Diamond Aircraft Industries GmbH Model DA-42 (Special Condition No. 23-169-SC) under TCDS No. A57CE<sup>3</sup> and later applied them to the Model DA-62, a derivative model that was added to the TCDS later. DAI-Canada plans to produce the Model DA-62 under a new type certificate (TC A00012NY); therefore, the FAA is issuing the same special conditions for the DAI-Canada Model DA-62.

Expecting the reintroduction of diesel engine technology into the small airplane fleet, the FAA issued Policy Statement PS-ACE100-2002-004, *Final Policy Statement; Diesel Engine*

---

<sup>3</sup> [http://rgl.faa.gov/Regulatory\\_and\\_Guidance\\_Library/rgMakeModel.nsf/0/EB54A4F565159645862583EE00756A7D?OpenDocument](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgMakeModel.nsf/0/EB54A4F565159645862583EE00756A7D?OpenDocument)

*Installation*, on May 15, 2004<sup>4</sup>, which identified areas of technological concern introduction of new technology diesel engines into small airplanes.

The general areas of concern involved the power characteristics of the diesel engines, the use of turbine fuel in an airplane class that has typically been powered by gasoline-fueled engines, and the vibration characteristics and failure modes of diesel engines. These concerns were identified after a review of the record of diesel engine use in airplanes and a review of the part 23 regulations, which identified specific regulatory areas that needed to be evaluated for applicability to aircraft diesel engine installations. These concerns are not considered universally applicable to all types of aircraft diesel engines and diesel engine installations. However, after review of the DAI Canada installation, the E4P engine type and the E4P requirements, and after applying the guidance in PS-ACE100-2002-004, the FAA has determined the fuel system and engine related special conditions previously issued in Special Condition No. 23-169-SC on Diamond Aircraft Industries GmbH Models DA 42, DA 42 NG, DA 42 M-NG, and DA62 airplanes are necessary for the DAI-Canada Model DA-62 airplane.

### **Type Certification Basis**

Under the provisions of 14 CFR 21.17, DAI-Canada must show that the Model DA-62 meets the applicable provisions of 14 CFR part 23, as amended by amendments 23-1 through 23-62 thereto.

If the Administrator finds that the applicable airworthiness regulations in part 23 do not contain adequate or appropriate safety standards for the Model DA-62 airplane because of a

---

<sup>4</sup> See [http://rgl.faa.gov/Regulatory\\_and\\_Guidance\\_Library/rgPolicy.nsf/0/CD377FA81E29D93A86256D440059EC2F?OpenDocument](http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgPolicy.nsf/0/CD377FA81E29D93A86256D440059EC2F?OpenDocument)

novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

The FAA issues special conditions, as defined in § 11.19, under § 11.38 and they become part of the type certification basis under § 21.17(a)(2).

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature, or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, the FAA would apply these special conditions to the other model.

In addition to the applicable airworthiness regulations and special conditions, the Model DA-62 must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36; and the FAA must issue a finding of regulatory adequacy under section 611 of Public Law 92-574, the "Noise Control Act of 1972."

### **Novel or Unusual Design Features**

The Model DA-62 will incorporate the following novel or unusual design feature:  
Installation of aircraft diesel engines that use turbine (jet) fuel.

### **Discussion**

The major concerns with diesel engine installations identified by the FAA include installing the diesel engine and noting its vibration levels under both normal operating conditions and when one cylinder is inoperative. The concerns also include accommodating turbine fuels in airplane systems that have generally evolved based on gasoline requirements, anticipated use of a FADEC to control the engine, and appropriate limitations and indications for a diesel engine

powered airplane. The general concerns associated with the aircraft diesel engine installation are as follows:

- Installation and Vibration Requirements
- Fuel and Fuel System Related Requirements
- Full Authority Digital Engine Control (FADEC) and Electrical System Requirements
- Limitations and Indications

*Installation and Vibration Requirements:* These special conditions include requirements similar to the requirements of § 23.901(d)(1) for turbine engines. In addition to the requirements of § 23.901 applied to reciprocating engines, the applicant will be required to construct and arrange each diesel engine installation to result in vibration characteristics that do not exceed those established during the type certification of the engine. These vibration levels must not exceed vibration characteristics that a previously certificated airframe structure has been approved for, unless such vibration characteristics are shown to have no effect on safety or continued airworthiness. The engine limit torque design requirements as specified in § 23.361 are also modified.

An additional requirement to consider vibration levels and/or effects of an inoperative cylinder was imposed. Also, a requirement to evaluate the engine design for the possibility of, or effect of, liberating high-energy engine fragments, in the event of a catastrophic engine failure was added.

*Fuel and Fuel System Related Requirements:* Due to the use of turbine fuel, this airplane must comply with the requirements in § 23.951(c).

Section 23.961 will be complied with using the turbine fuel requirements. These requirements will be substantiated by flight-testing as described in Advisory Circular AC 23-8C, Flight Test Guide for Certification of Part 23 Airplanes.

This special condition specifically requires testing to show compliance with § 23.961 and adds the possibility of testing non-aviation diesel fuels.

To ensure fuel system compatibility and reduce the possibility of misfueling, and discounting the first clause of § 23.973(f) referring to turbine engines, the applicant will comply with § 23.973(f).

Due to the use of turbine fuel, the applicant will comply with § 23.977(a)(2), and § 23.977(a)(1) will not apply. "Turbine engines" will be interpreted to mean "aircraft diesel engines" for this requirement. An additional requirement to consider the possibility of fuel freezing was imposed.

Due to the use of turbine fuel, the applicant will comply with § 23.1305(c)(8).

Due to the use of turbine fuel, the applicant must comply with § 23.1557(c)(1)(ii). Section 23.1557(c)(1)(ii) will not apply. "Turbine engine" is interpreted to mean "aircraft diesel engine" for this requirement.

*FADEC and Electrical System Requirements:* The electrical system must comply with the following:

- In case of failure of one power supply of the electrical system, there will be no significant engine power change. The electrical power supply to the FADEC must remain stable in such a failure.



- The transition from the actual engine electrical network (FADEC) to the remaining electrical system with the consumer's, avionics, communication, etc., should be made by a single point only. If several transitions (e.g., for redundancy reasons) are needed, then the number of the transitions must be kept as small as possible.
- There must be the ability to separate the FADEC power supply (alternator) from the battery and from the remaining electrical system.
- In case of loss of alternator power, the installation must guarantee that the battery will provide the power for an appropriate time after appropriate warning to the pilot.
- FADEC, alternator, and battery must be interconnected in an appropriate way so, in case of loss of battery power, the supply of the FADEC is guaranteed by the alternator.

#### *Limitations and Indications*

Section 23.1305(a) and (b)(2) will apply, except that propeller revolutions per minute (RPM) will be displayed. Section 23.1305(b)(4), (5), and (7) are deleted.

Additional critical engine parameters for this installation that will be displayed include—

- (1) Power setting, in percentage (in place of manifold pressure); and
- (2) Fuel temperature.

Due to the use of turbine fuel, the requirements for § 23.1521(d), as applicable to fuel designation for turbine engines, will apply.

#### **Applicability**

As discussed above, these special conditions are applicable to the DAI-Canada Model DA-62. Should DAI-Canada apply at a later date for a change to the type certificate to include

another model incorporating the same novel or unusual design feature, the FAA would apply these special conditions to that model as well.

## **Conclusion**

This action affects only certain novel or unusual design features on the Model DA-62 airplane. It is not a rule of general applicability and it affects only the applicant who applied to the FAA for approval of these features on the airplane.

## **List of Subjects in 14 CFR Part 23**

Aircraft, Aviation safety, Signs and symbols.

## **Citation**

The authority citation for these special conditions is as follows:

**Authority:** 49 U.S.C. 106(f), 106(g), 40113, 44701-44702, 44704, Pub. L. 113-53, 127 Stat. 584 (49 U.S.C. 44704) note.

## **The Special Conditions**

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for Diamond Aircraft Industries of Canada Model DA-62 airplanes.

### **1. Engine torque (Provisions similar to § 23.361, paragraphs (b)(1) and (c)(3)):**

a. For diesel engine installations, the engine mounts and supporting structure must be designed to withstand the following:

(1) A limit engine torque load imposed by sudden engine stoppage due to malfunction or structural failure.

(a) The effects of sudden engine stoppage may alternatively be mitigated to an acceptable level by utilization of isolators, dampers clutches, and similar provisions, so unacceptable load levels are not imposed on the previously certificated structure.

b. The limit engine torque to be considered under § 23.361(a) must be obtained by multiplying the mean torque by a factor of four for diesel cycle engines.

(1) If a factor of less than four is used, it must be shown that the limit torque imposed on the engine mount is consistent with the provisions of § 23.361(c). In other words, it must be shown that the use of the factors listed in § 23.361(c)(3) will result in limit torques on the mount that are equivalent to or less than those imposed by a conventional gasoline reciprocating engine.

## **2. Powerplant -- Installation (Provisions similar to § 23.901(d)(1) for turbine engines):**

Considering the vibration characteristics of diesel engines, the applicant must comply with the following:

a. Each diesel engine installation must be constructed and arranged to result in vibration characteristics that—

(1) Do not exceed those established during the type certification of the engine; and

(2) Do not exceed vibration characteristics that a previously certificated airframe structure has been approved for—

(i) Unless such vibration characteristics are shown to have no effect on safety or continued airworthiness, or

(ii) Unless mitigated to an acceptable level by utilization of isolators, dampers clutches, and similar provisions, so that unacceptable vibration levels are not imposed on the previously certificated structure.

**3. Powerplant -- Fuel System -- Fuel system with water saturated fuel (Compliance with § 23.951 requirements):**

Considering the fuel types used by diesel engines, the applicant must comply with the following:

a. Each fuel system for a diesel engine must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 80° F and having 0.75cc of free water per gallon added and cooled to the most critical condition for icing likely to be encountered in operation.

b. Methods of compliance that are acceptable for turbine engine fuel systems requirements of § 23.951(c) are also considered acceptable for this requirement.

**4. Powerplant -- Fuel System -- Fuel system hot weather operation (Compliance with § 23.961 requirements):**

In place of compliance with § 23.961, the applicant must comply with the following:

a. Each fuel system must be free from vapor lock when using fuel at its critical temperature, with respect to vapor formation, when operating the airplane in all critical operating and environmental conditions for which approval is requested. For turbine fuel, or for aircraft equipped with diesel cycle engines that use turbine or diesel type fuels, the initial temperature must be 110°F, -0°, +5°, or the maximum outside air temperature for which approval is requested, whichever is the most critical.

b. The fuel system must be in an operational configuration that will yield the most adverse, that is, conservative results.

c. To comply with this requirement, the applicant must use the turbine fuel requirements and must substantiate these by flight-testing, as described in Advisory Circular AC 23-8C, Flight Test Guide for Certification of Part 23 Airplanes.

**5. Powerplant -- Fuel system -- Fuel tank filler connection (Compliance with § 23.973(f) requirements):**

In place of compliance with § 23.973(e) and (f), the applicant must comply with the following:

For airplanes that operate on turbine or diesel type fuels, the inside diameter of the fuel filler opening must be no smaller than 2.95 inches.

**6. Powerplant -- Fuel system -- Fuel tank outlet (Compliance with § 23.977 requirements):**

In place of compliance with § 23.977(a)(1) and (2), the applicant will comply with the following:

There must be a fuel strainer for the fuel tank outlet or for the booster pump. This strainer must, for diesel engine powered airplanes, prevent the passage of any object that could restrict fuel flow or damage any fuel system component.

**7. Powerplant -- Powerplant Controls and Accessories -- Engine ignition systems (Compliance with § 23.1165 requirements):**

Considering that the FADEC provides the same function as an ignition system for this diesel engine, in place of compliance with § 23.1165, the applicant will comply with the following:

a. The electrical system must comply with the following requirements:

(1) In case of failure of one power supply of the electrical system, there will be no significant engine power change. The electrical power supply to the FADEC must remain stable in such a failure.

(2) The transition from the actual engine electrical network (FADEC network) to the remaining electrical system should be made at a single point only. If several transitions (for example, redundancy reasons) are needed, then the number of the transitions must be kept as small as possible.

(3) There must be the ability to separate the FADEC power supply (alternator) from the battery and from the remaining electrical system.

(4) In case of loss of alternator power, the installation must guarantee the battery will provide the power for an appropriate time after appropriate warning to the pilot. This period must be at least 30 minutes required, 60 minutes desired.

(5) FADEC, alternator, and battery must be interconnected in an appropriate way so, in case of loss of battery power, the supply of the FADEC is guaranteed by the alternator.

## **8. Equipment -- General -- Powerplant Instruments (Compliance with § 23.1305 requirements):**

a. In place of compliance with § 23.1305, the applicant will comply with the following:

(1) The following are required powerplant instruments:

(a) A fuel quantity indicator for each fuel tank, installed in accordance with § 23.1337(b).

(b) An oil pressure indicator.

(c) An oil temperature indicator.

(d) A tachometer indicating propeller speed.

(e) A coolant temperature indicator.

(f) An indicating means for the fuel strainer or filter required by § 23.997 to indicate the occurrence of contamination of the strainer or filter before it reaches the capacity established in accordance with § 23.997(d).

1. No indicator is required if the engine can operate normally for a specified period with the fuel strainer exposed to the maximum fuel contamination as specified in MIL-5007D and provisions for replacing the fuel filter at this specified period (or a shorter period) are included in the maintenance schedule for the engine installation.

(g) Power setting, in percentage.

(h) Fuel temperature.

(i) Fuel flow (engine fuel consumption).

**9. Operating Limitations and Information -- Powerplant limitations -- Fuel grade or designation (Compliance with § 23.1521(d) requirements):**

Instead of compliance with § 23.1521(d), the applicant must comply with the following:

The minimum fuel designation (for diesel engines) must be established so it is not less than that required for the operation of the engines within the limitations in paragraphs (b) and (c) of § 23.1521.

**10. Markings And Placards -- Miscellaneous markings and placards -- Fuel, oil, and coolant filler openings (Compliance with § 23.1557(c)(1) requirements):**

Instead of compliance with § 23.1557(c)(1), the applicant must comply with the following:

a. Fuel filler openings must be marked at or near the filler cover with—

(1) For diesel engine-powered airplanes—

(a) The words “Jet Fuel”; and

(b) The permissible fuel designations, or references to the Airplane Flight Manual (AFM) for permissible fuel designations.

(c) A warning placard or note that states the following or similar:

"Warning -- this airplane equipped with an aircraft diesel engine, service with approved fuels only."

The colors of this warning placard should be black and white.

#### **11. Powerplant -- Fuel system -- Fuel-Freezing:**

If the fuel in the tanks cannot be shown to flow suitably under all possible temperature conditions, then fuel temperature limitations are required. These will be considered as part of the essential operating parameters for the aircraft and must be limitations.

a. The takeoff temperature limitation must be determined by testing or analysis to define the minimum cold-soaked temperature of the fuel that the airplane can operate on.

b. The minimum operating temperature limitation must be determined by testing to define the minimum operating temperature acceptable after takeoff (with minimum takeoff temperature established in (a) of this paragraph).

#### **12. Powerplant Installation -- Vibration levels:**

a. Vibration levels throughout the engine operating range must be evaluated and:

(1) Vibration levels *imposed on the airframe* must be less than or equivalent to those of the gasoline engine; or

(2) Any vibration level that is higher than that imposed on the airframe by the replaced gasoline engine must be considered in the modification and the effects on the technical areas covered by the following paragraphs must be investigated:



14 CFR part 23, §§ 23.251; 23.613; 23.627; 23.629 (or CAR 3.159, as applicable to various models); 23.572; 23.573; 23.574 and 23.901.

b. Vibration levels imposed on the airframe can be mitigated to an acceptable level by use of isolators, dampers clutches, and similar provisions, so unacceptable vibration levels are not imposed on the previously certificated structure.

### **13. Powerplant Installation -- One cylinder inoperative:**

It must be shown by test or analysis, or by a combination of methods, that the airframe can withstand the shaking or vibratory forces imposed by the engine if a cylinder becomes inoperative. Diesel engines of conventional design typically have extremely high levels of vibration when a cylinder becomes inoperative. Data must be provided to the airframe installer/modifier so either appropriate design considerations or operating procedures, or both, can be developed to prevent airframe and propeller damage.

### **14. Powerplant Installation -- High Energy Engine Fragments:**

It may be possible for diesel engine cylinders (or portions thereof) to fail and physically separate from the engine at high velocity (due to the high internal pressures). This failure mode will be considered possible in engine designs with removable cylinders or other non-integral block designs. The following is required:

a. It must be shown that the engine construction type (massive or integral block with non-removable cylinders) is inherently resistant to liberating high energy fragments in the event of a catastrophic engine failure; or,

b. It must be shown by the design of the engine, that engine cylinders, other engine components or portions thereof (fragments) cannot be shed or blown off the engine in the event of a catastrophic engine failure; or

c. It must be shown that all possible liberated engine parts or components do not have adequate energy to penetrate engine cowlings; or

d. Assuming infinite fragment energy, and analyzing the trajectory of the probable fragments and components, any hazard due to liberated engine parts or components will be minimized and the possibility of crew injury is eliminated. Minimization must be considered during initial design and not presented as an analysis after design completion.

Issued in Kansas City, Missouri on October 3, 2019.

William Schinstock

Acting Manager, Small Airplane Standards Branch

Policy and Innovation Division

Aircraft

Certification

Service

[FR Doc. 2019-22118 Filed: 10/9/2019 8:45 am; Publication Date: 10/10/2019]